NATIONAL BUREAU OF STANDARDS REPORT

8556

VAPORIZATION OF THERMIONIC

REFRACTORY MATERIALS

August 31, 1964

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Twelfth Status Report for the period June 1, 1964 - August 31, 1964
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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

I. LITERATURE DATA ON RATE OF SUBLIMATION OF RHENIUM

The only published experimental data concerning the rate of sublimation of rhenium is due to Sherwood et al [1]. Their data were obtained by the Langmuir method using a modification of the hot wire method and utilizing an emissivity correction to obtain true temperatures. From a least squares treatment of their 7 experimental points, Sherwood et al reported a second law heat of sublimation, valid for an average temperature of about 2700°K, of 187.0 kcal $mole^{-1}$. This can be corrected to a second law heat of sublimation at 298°K of 193.1 kcal $mole^{-1}$ using the enthalpy functions for rhenium listed by Stull and Sinke [2]. A third law treatment of the pressure data using the free energy functions listed by Stull and Sinke yields an average third law heat of 185.7 ± 1.0 kcal $mole^{-1}$ at 298°K.

II. EXPERIMENTAL WORK ON RHENIUM

Some preliminary rate of sublimation data have been obtained on a zone refined sample of rhenium obtained from Metals Research Corporation, Orangeburg, New York. The results of a semi-quantitative spectrochemical analysis performed at NBS and a "typical" analysis supplied by MRC are listed in table 1. These data indicate that no contaminant of any consequence is present in the material supplied.

The five data points obtained in this study are considered preliminary because the temperature obtained on the first experimental point was higher than anticipated and a significant amount of rhenium was deposited on the window through which temperatures are read. This resulted in a larger uncertainty in the window correction than we

considered desirable. Therefore, this series of measurements was terminated and a new window correction was obtained.

The results of this preliminary series are listed in table 2. An average third law heat of sublimation of 186.8 ± 0.4 kcal $mole^{-1}$ at 298°K and a second law heat at 298°K of 188.7 ± 3.4 kcal $mole^{-1}$ were obtained. These results are in reasonably good agreement with those of Sherwood et al, but because of the relatively large uncertainty in temperature, it is planned to carry out a second series of measurements.

TABLE I

Semi-Quantitative Spectrochemical Analysis
of Rhenium

Element	NBS	MRC
	*	PPM
Ca	T	
Cu	vw	
Fe	T	<10
Mg	T	
Mo	--	40
Si	vw	10
W	--	
O_2		12
H		0.8
C		2.0
N_2		<1.0

* vw, .001 - .01%; T, .0001 - .001%; --, not detected.

TABLE II

Preliminary Results on
Rate of Vaporization of Rhenium

T°K	P(atm) x 10^7	$\Delta H_s^\circ(298)$
3080	13.2	186.5
2640	.0974	186.6
2724	.247	187.3
2812	.724	187.1
2856	1.30	186.6
Mean $\Delta H_s^\circ(298)$ ----------		186.8 ± 0.4 kcal

References

[1] E. M. Sherwood, D. M. Rosenbaum, J. M. Blocher, Jr., and I. E. Campbell, J. Electro. Soc. 102, 650 (1955)

[2] D. R. Stull and G. C. Sinke, Thermodynamic Properties of the Elements, American Chemical Society, Washington, D. C. (1956)